

Evolution of Mining Practices in the Western Lake Superior Area

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Native Americans were the first miners

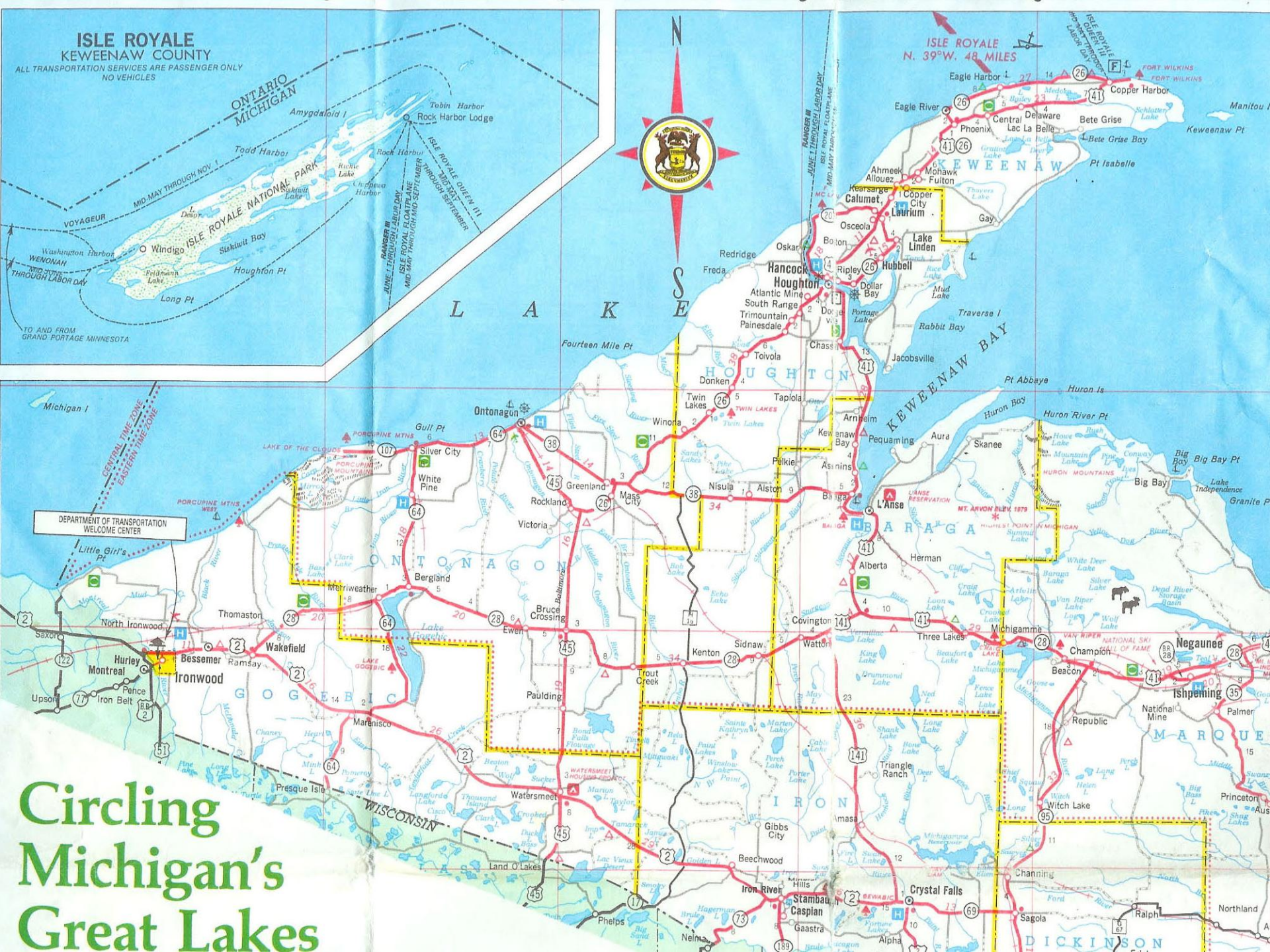
- Open pits and shallow shafts
- Keweenaw Peninsula & Isle Royale
- Fire & water to break rock
- Hammer stones to free copper
- Made tools, weapons, jewelry
- Trade routes were the rivers & lakes
- 4000 to 7000 years ago



L. LESKINEN

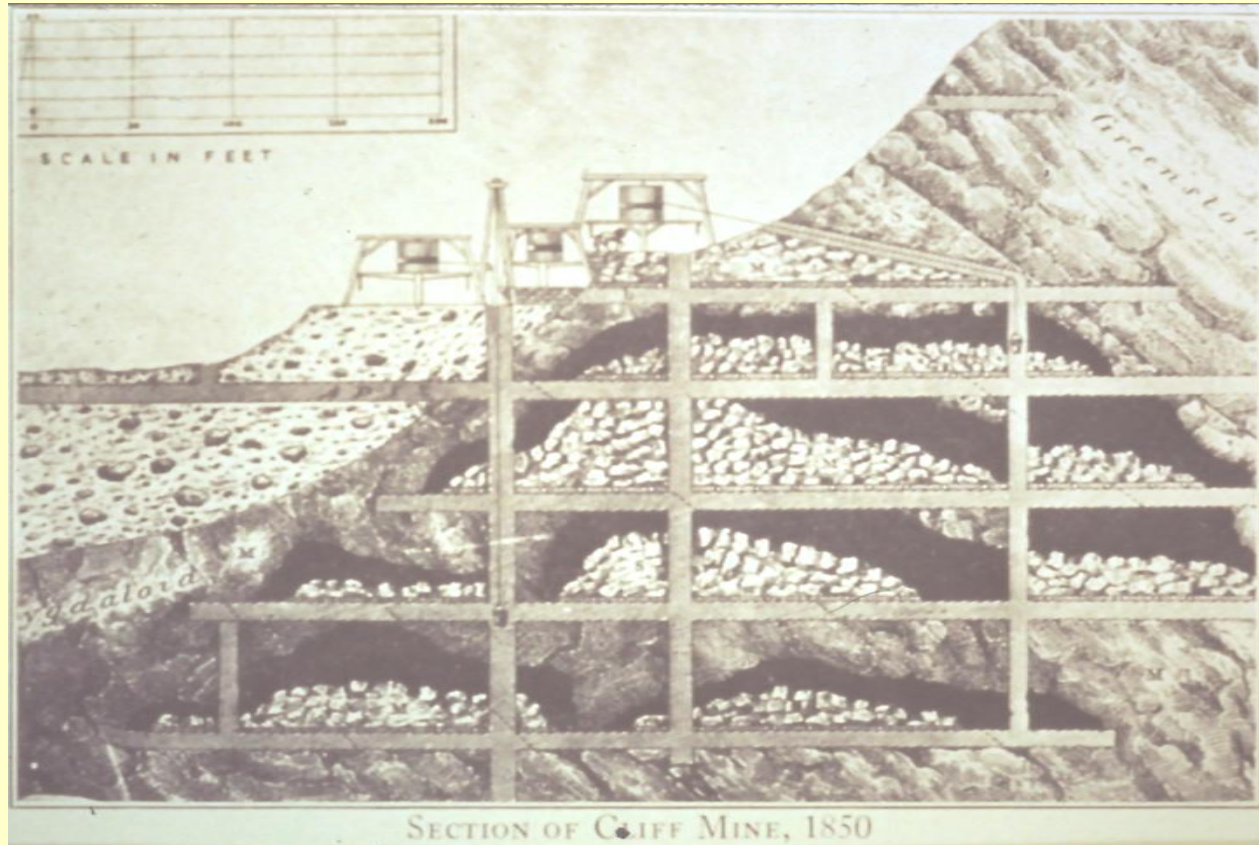
ISLE ROYALE KEWEENAW COUNTY

ALL TRANSPORTATION SERVICES ARE PASSENGER ONLY
NO VEHICLES

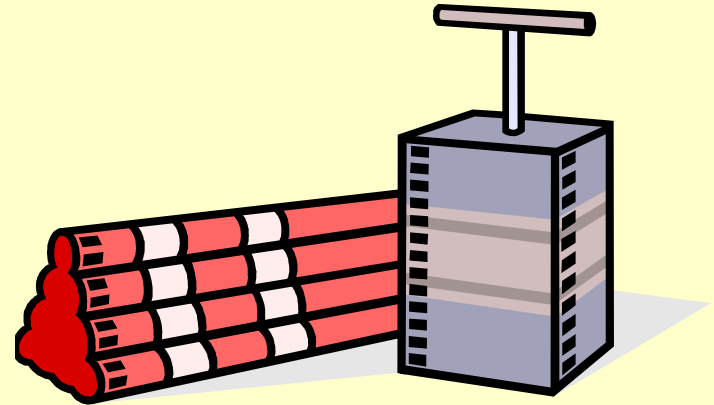


Circling
Michigan's
Great Lakes

Early native copper mining



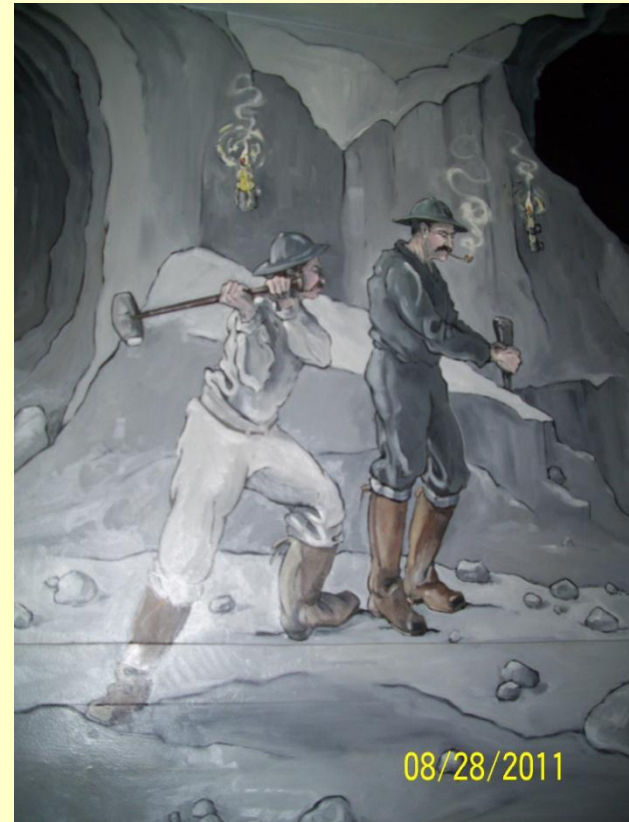
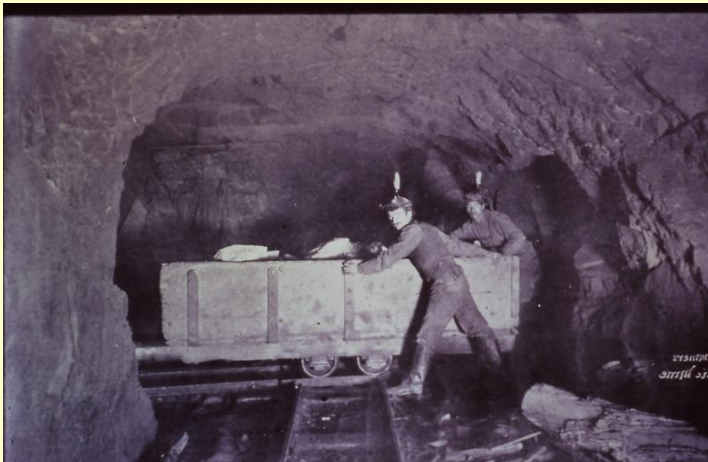
Miners: drill, blast, load and haul



Early iron ore mining



Early copper mining



Technological advances in mining

drilling	steel drill & sledge	steam powered	air powered	drilling machine
blasting	blasting powder	nitro- glycerine	dynamite	ANFO & additives
loading	load by hand	steam or air	electric power	diesel power
hauling	horse & cart	tram/rail tracks	LHD machine	boat & rail

Status of Michigan mining by early 1970's

- Native copper mines closed
- Underground iron ore mines closed
- All iron ore production from huge open pits



Many hundreds of Closed Mines in Michigan's W. Upper Peninsula

- Earliest laws – rails around shaft
- County mine inspectors
 - Yearly inspections and reports
- Later practices:
 - Fencing, warning signs
 - Shaft capping
 - Shaft filling in some cases
 - Bat cages for selected mines

Failed mine shaft capping



Open mine fenced shaft



A group of approximately ten people, mostly men, are gathered in a wooded area with bare trees in the background. They are wearing various types of work clothes and hard hats, including orange, yellow, and white. Two individuals are actively working in a deep, narrow trench that has been dug into the ground. One person is using a shovel, while another is crouched nearby. Several other people are standing around the trench, observing the work. One man in the foreground is holding a long metal pole or tool. A yellow date stamp "4 24 92" is visible in the bottom right corner of the image.

Open fenced shaft near school

- Teenager death
- Drowns in mine stope
- Popular hangout



Mine subsidence



W. Menonminee Range mines



- In 40, 80, 160 acre parcels.
- Major roads built on section lines
- Small mining co's may mine to their property boundary and leave no or inadequate pillars

Piping subsidence in overburden



Pit one year later



Illustration of piping subsidence

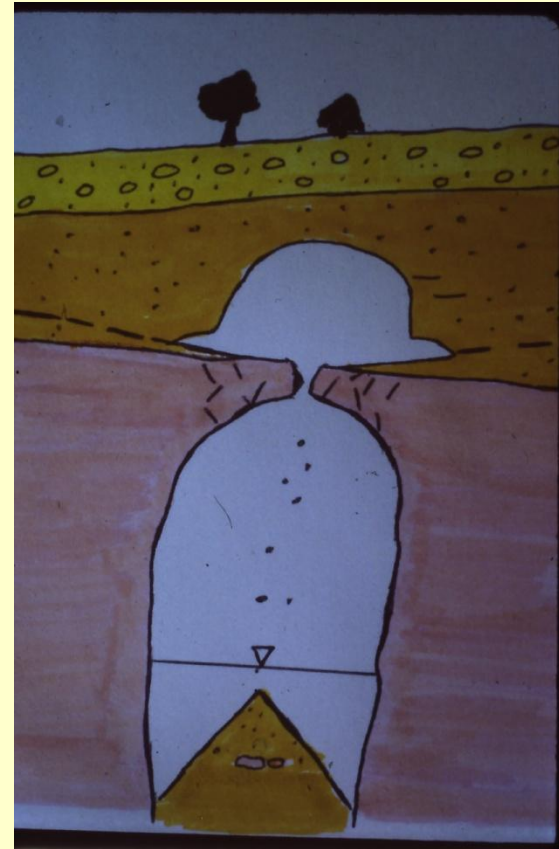
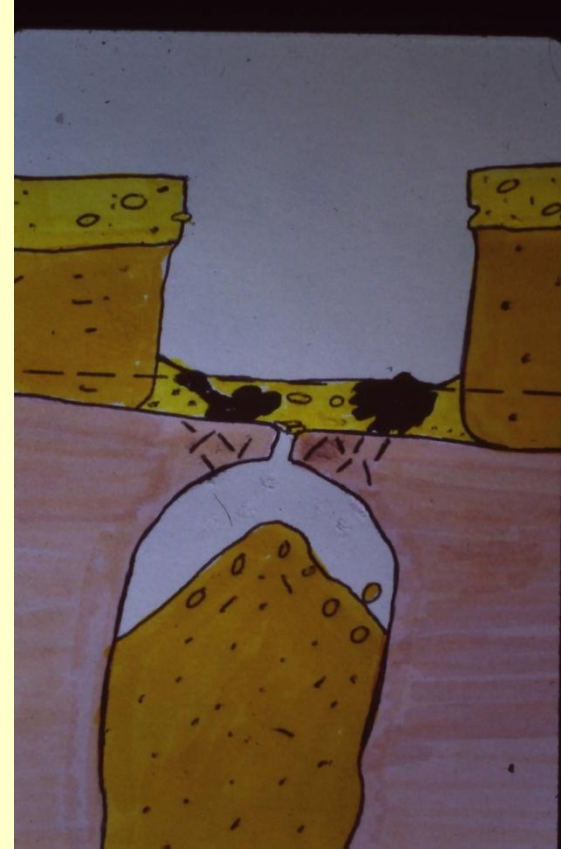
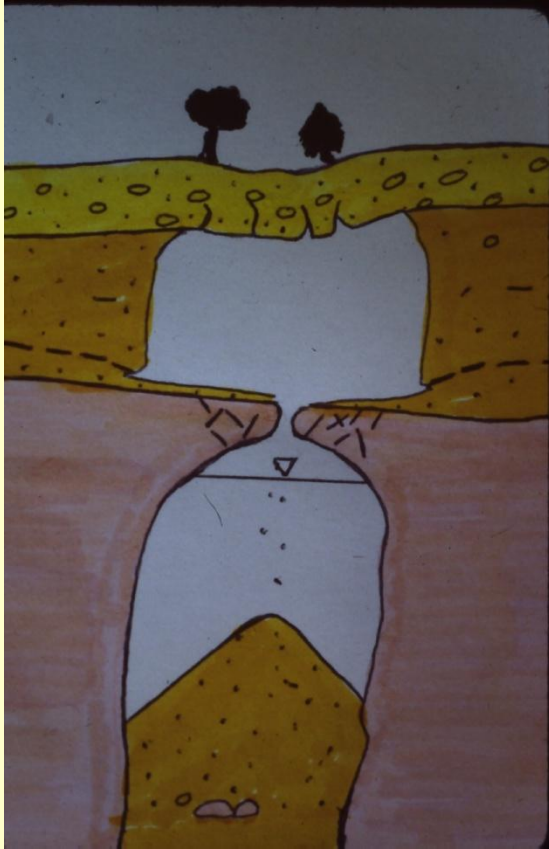


Illustration of piping subsidence



Acid mine water drainage





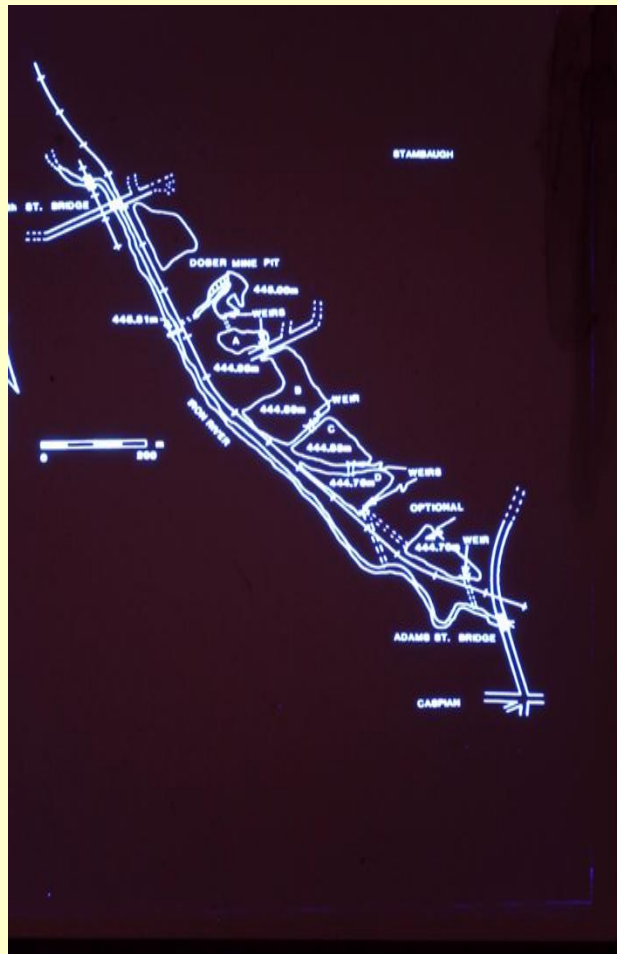
Dober mine pit acid water

- Acid water is clear
- Cloudy when acid is neutralized
- Iron hydroxide precipitate or “yellow boy”





Low cost pond system idea



- Bring river water into Dober pit to neutralize acid
- Treated water flows into downstream ponds to let iron settle
- Return clear water to river downstream

First Michigan superfund project



Gravity system installed



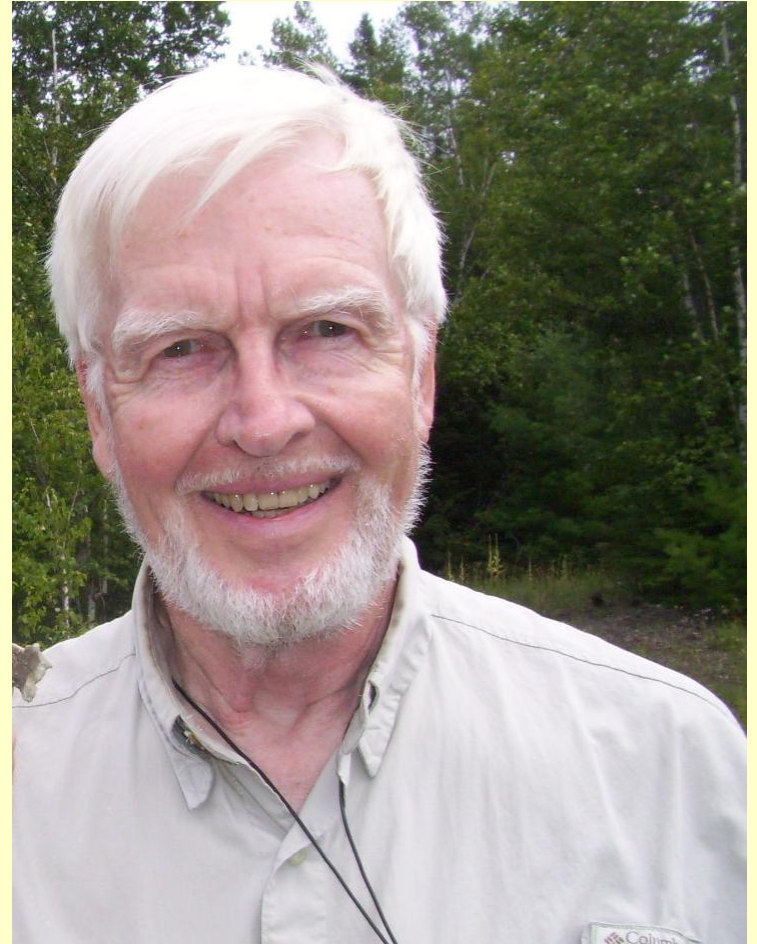




Summary & Recommendations

Mining is evolving --

- In addition to drill, blast, load & haul
- Add mine closure engineering and design to avoid environmental problems



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